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Publications

# the survival OF THE ST. LAWRENCE beluga whale

ANNUAL REPORT  
1991-1992



Fisheries  
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ST. LAWRENCE ACTION PLAN

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The Honourable John Crosbie  
*Minister of Fisheries and Oceans*

The Honourable Jean Charest  
*Minister of the Environment*

Dear Sirs:

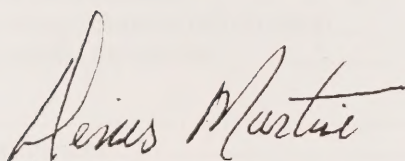
We have the honour to submit the fourth annual report on the *Interdepartmental Action Plan to Favour the Survival of the St. Lawrence Beluga*. This report summarizes the main results of the Plan for both your departments during the 1991-1992 fiscal year.

The Action Plan has four themes: **increasing our knowledge** of the St. Lawrence beluga population and its habitat, **preventing and controlling disturbances** by vessel traffic, **reducing toxic substances** in its habitat and in the St. Lawrence as a whole, and promoting public awareness of conservation through **the communication of information**.

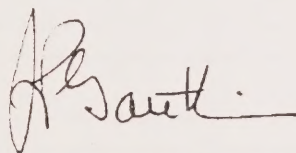
The main results presented in this report are related to these four themes. It was shown that the population has remained stable at approximately 500 individuals, with a constant proportion of young animals in the herd, estimated at 30%. The level of contamination in the population has also remained unchanged. It seems that the pathway for the accumulation of contaminants in the population is mostly through feeding on fish, notably eel, and by transfer from cows to calves during pregnancy. Traces of contaminants are found throughout the food web, from bacteria to phytoplankton and zooplankton. However, the levels of most chemical substances found in fish and invertebrates in the Saguenay River are usually low. The efforts to control and reduce industrial pollution were pursued in 1991-1992; of the industries targeted in the St. Lawrence Action Plan, 45 have either produced a corrective plan or are subject to current regulations, and 16 have already achieved corrective measures. Finally, the control and prevention of whale disturbance by vessel traffic remained a focus of activity, as did the communication of information and promotion of public awareness.

We hope that this report will meet your expectations and those of the public in support of continued efforts to save the St. Lawrence beluga.

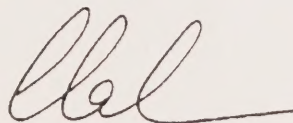
Respectfully yours,



**DENIS MARTIN**  
*Regional Director General*  
Department of Fisheries  
and Oceans  
Quebec Region



**JEAN-PIERRE GAUTHIER**  
*Regional Director General*  
Conservation and Protection  
Environment Canada  
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*Regional Director General*  
Parks Service  
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# Table of contents

<b>Favouring the survival of the St.Lawrence beluga .....</b>	<b>1</b>
<b>Increasing our knowledge of the beluga .....</b>	<b>3</b>
The St.Lawrence beluga population .....	3
Limiting factors .....	4
Habitat conservation .....	5
The rescue of a young beluga .....	5
<b>Controlling disturbances .....</b>	<b>7</b>
Reducing the impact of vessel traffic .....	7
The Saguenay marine park .....	8
<b>Reducing toxic substances .....</b>	<b>9</b>
Environmental toxicity of contaminants .....	9
Contaminant flux in the beluga's food chain .....	9
Transport of pollutants .....	10
Controlling toxic waste .....	11
<b>Communications information .....</b>	<b>13</b>
Communicating scientific information .....	13
Promoting public awareness .....	13
<b>Conclusion .....</b>	<b>17</b>
Financial summary .....	17
Summary of results .....	18
Upcoming activities .....	19



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# Favouring the survival of the St. Lawrence beluga



Located at the southern limit of the beluga's range in North America, the St. Lawrence population is found in the St. Lawrence estuary, from Ile aux Coudres downstream to Sept Iles, and in the Saguenay fjord, from the mouth of the fjord upstream to just beyond Baie des Ha! Ha! The seasonal distribution of this population is shown on the following page.

Human activity, mostly the intense whaling conducted until 1978, is partly responsible for the decline of the population from an estimated 5 000 individuals in 1885 to a mere 500 individuals since the 1970s.

The first in a series of measures to save this whale population came in 1978 in the form of specific regulations legislating blanket protection for the beluga. In 1983, the St. Lawrence beluga was designated an endangered population by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). In 1986, the Department of Fisheries and Oceans created a federal-provincial interdepartmental committee commissioned to identify the problems facing the beluga population and to devise and implement corrective action.

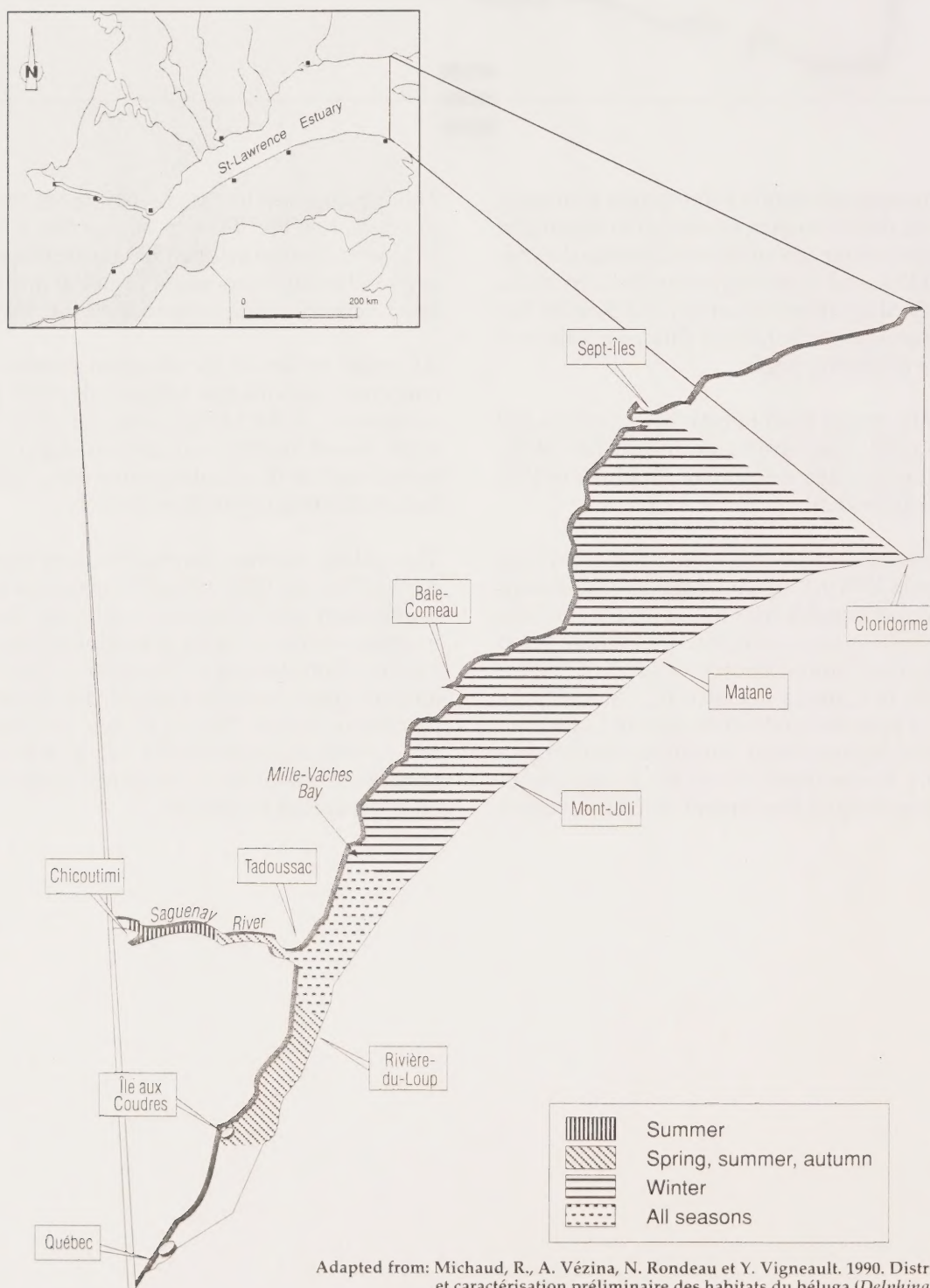
This process led to the development of the *Interdepartmental Action Plan to Favour the Survival of the St. Lawrence Beluga* in June 1988, implemented under the aegis of the departments of Fisheries and Oceans and Environment Canada, as part of the *St. Lawrence Action Plan*.

An initial review of the situation showed three main concerns: lack of knowledge of the biology and characteristics of the beluga, coupled with disturbance from vessel traffic, and contamination from toxic substances in their habitat and prey, both potential factors limiting population growth.

These three themes shaped the development of the Action Plan. In 1989, a fourth theme was added: communication of information to educate the public and increase awareness of the fate of the beluga population and the efforts to save it. This report is the fourth of five annual reports summarizing the results of the *Interdepartmental Action Plan to Favour the Survival of the St. Lawrence Beluga* in 1991-1992. A table showing departmental involvement in each of the activities is given at the end of the report.



# Seasonal distribution of the St. Lawrence beluga



Adapted from: Michaud, R., A. Vézina, N. Rondeau et Y. Vigneault. 1990. Distribution annuelle et caractérisation préliminaire des habitats du béluga (*Delphinapterus leucas*) du Saint-Laurent. Rapp. tech. can. sci. halieut. et aquat. 1757: v+31p.



# Increasing our knowledge of the beluga

As part of the Action Plan, a research program was established to fill in the gaps in our knowledge of the beluga in general, and of the St. Lawrence population in particular, under which current knowledge is being pooled and new lines of research developed to better understand its needs. Aspects covered include population census, population dynamics and distribution, and the factors limiting population growth. Management tools to preserve the population's critical habitats were also developed. Finally, an attempt made in 1991 to save an orphan calf provided original information on previously little known life parameters.

## The St. Lawrence beluga population

In order to provide maximum protection for, and to forecast population trends, as well as assess the results of our efforts on its behalf, it is essential to increase our knowledge of fluctuations in the population, its overall distribution in the St. Lawrence, and dynamics.

The St. Lawrence beluga population is presently estimated at about 500 individuals and is believed to be stable at this level. The most recent population estimates vary from 431 to 606 individuals, with a wide margin of error, sometimes up to 50%, due to the census techniques used. The variations in the estimates are the result of a small population distributed over a very large territory, coupled with the gregarious behaviour of the species and its underwater behavior.

The distribution of the beluga population in the St. Lawrence has been thoroughly investigated since 1989, as shown in the preceding distribution map. From spring to fall, the whales are found mostly in the

### St. Lawrence Beluga Population Estimates



downstream portion of the Saguenay River and in the St. Lawrence estuary, between Ile aux Coudres and Mille-Vaches Bay. In winter, the herd moves downstream, reaching as far as Sept Iles on the north shore and Cloridorme along the south shore of the estuary. Baie Saint-Marguerite in the Saguenay River was found to be a favourite summer habitat, although, as in the rest of the Saguenay River, newborn calves are fairly rare.

Other recent results indicate that grey-coloured juveniles are not evenly distributed among pods; their



proportion is steady at 39 to 40% in pods observed upstream of the Saguenay and St. Lawrence confluence, but varies greatly (0-30%) in pods downstream from that limit.

**Population dynamics** is the subject of various ongoing studies. A mortality rate pattern is being produced through the age analysis of stranded whales; preliminary results indicate a peak of mortality at 20 years of age and a very small number of young animals in the sample.

Population growth potential is estimated from boat censuses of juveniles and newborn calves; a mean value of 30% indicates that the population is probably stable at its current level. Birth rate and survival rate of calves will be evaluated by two different techniques. A macroscopic examination of female reproductive organs from stranded animals will be initiated in 1992, and the number of newborn and juveniles will be estimated by the analysis of aerial photographs; the first series was taken in 1991.

Three typical social units were identified during an extensive field survey in Baie Saint-Marguerite: pods composed exclusively of adult whales averaging 15 individuals, mixed pods of about 25 adults and juveniles with one-third young whales, and pods made up of adults, juveniles and newborn calves with juveniles generally making up over 40% of the group. The most abundant units are the mixed pods composed of adults and juveniles.

## Limiting factors

The growth of the St. Lawrence beluga population may be reduced and even totally hampered by various limiting factors, such as stress, contaminants and diet.

**Response of beluga to stress** can be evaluated by recording variations in vocalization patterns in the presence of vessels or small craft. Preliminary results indicate noticeable changes in the frequency of whistles emitted during disturbance.

**Contaminants** in the beluga have been measured in stranded animals since 1988, and 16 carcasses were thus

examined in 1991-1992. Results indicate that the level of contamination is much higher in the St. Lawrence beluga than in arctic populations: 10 times for lead and 72 times for mirex. However it has remained stable during those years. Other heavy metals and chlorinated organic compounds, such as polychlorinated biphenyls (PCB), dichloro-diphenyl trichloroethane (DDT), and traces of polycyclic aromatic hydrocarbons (PAH) have also been detected in beluga tissues.

Mortality due to fishing nets and wounds from boat collision are not thought to be major causes of death in the beluga population. Poor health condition caused by the presence of contaminants in the tissues remains the major death factor under study in stranded animals.

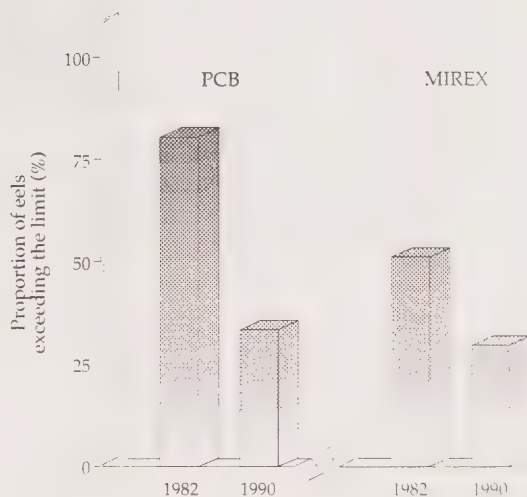
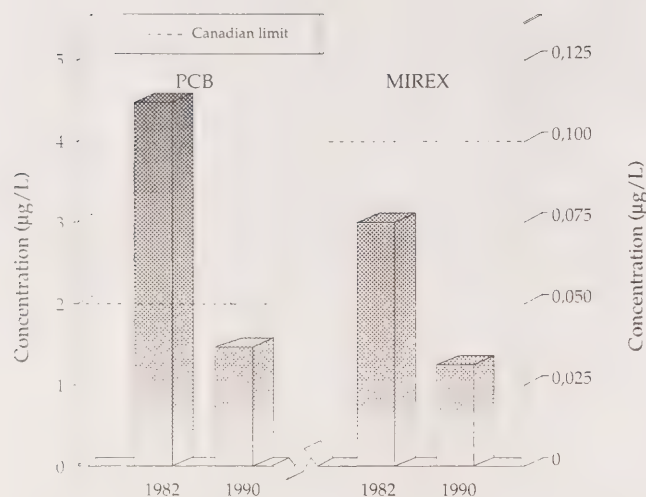
**The beluga's diet** may also affect population growth as it is the likely source of contaminant accumulation. In 1990, research was initiated to measure the concentrations of various toxic substances in the American eel and verify their potential transfer to the beluga. The results of chemical analysis of eel tissues are compared with those from a similar study conducted in 1982, and are presented in the following figure. The mean concentration of contaminants in eels captured at Kamouraska decreased between 1982 and 1990 by 68% for PCBs and by 56% for mirex. Also, the proportion of fish in which contaminants exceeded the acceptable level for human consumption decreased from 80% in 1982 to 36% in 1990 for PCBs, and from 59% to 29% for mirex. The occurrence of external deformities was found to be higher in the estuary eel stock than in the North Shore population.

A model for contaminant accumulation in the beluga demonstrates that consuming contaminated eels and contaminant transfer from cow to calf during pregnancy are largely responsible for the bioaccumulation of contaminants in the whales.

The characterization of benthic communities and the analysis of contaminants at three sites frequented by the beluga, Kamouraska, Iles aux Fraises and Saint-Simeon, was completed in 1991. Low levels of contaminants were found at all three sites and there was no relationship between contaminants and biophysical parameters, except for pesticides and certain benthic organisms. Thus this study suggests that benthic communities cannot be considered a direct, significant source of contamination for the St. Lawrence beluga.



## Evolution of contaminant concentrations in American eel tissues from Kamouraska



## Habitat conservation

Conservation of the beluga's habitat, as well as the habitats of other marine resources, hinges on identifying and characterizing them, then understanding the environmental factors affecting their quality.

The Integrated Information System for Fish Habitat Management (I.I.S.F.H.M.), under development since 1989, consists in several databanks and interactive programs. The *Beluga* database is already functional and is designed to gather information on the beluga habitat in the St. Lawrence. The database in the *Beluga* program includes data on group distribution by sector and data on the distribution of potential food items. It is supported by a map showing habitats and the annual and seasonal distribution of the St. Lawrence beluga.

A three-dimensional water current model is being developed for the St. Lawrence estuary. This model is a versatile tool supplying information on water circulation and sediment and contaminant transport and dispersal. It will serve as a predictive model in case of environmental emergencies.

There are two major phases to this project: the modeling as such, and the calibration of the model with current, tide and wind measurements. The model has been completed and its calibration is underway; since 1990, data has been collected on depth, currents and tidal fronts at several sites in the estuary.

## The rescue of a young beluga

On August 20, 1991, the rescue of an orphan calf was attempted for the first time in Quebec. Considerable efforts were made to save it and for a brief period the rescue attempt looked promising. Then the beluga died on August 30 at the Quebec Aquarium, in Ste Foy. During the rescue operation, several organizations collaborated actively, including the St. Lawrence National Institute of Ecotoxicology, the Department of Fisheries and Oceans, and the Quebec Aquarium. Outside assistance came from experts from the John G. Shedd Aquarium in Chicago, the New York Zoological Society and the Minnesota Zoological Garden. To this

day, only one attempt to rescue such a young cetacean has succeeded worldwide; thus the Quebec operation was a pioneering effort.

Although the rescue operation was unsuccessful, valuable information and increased knowledge were gained on the nursing requirements of a newborn calf and on its behaviour and assessment of its vital signs. Immediately after it was captured, the rescuers had to face problems such as hypothermia, hypoglycaemia, and infection of injuries. They had to devise a special emergency diet; the calf had to be transported rapidly to a suitable site.



Then, captivity posed the problems of adequate diet, medication and acclimatization to a limited swimming area. The autopsy revealed the presence of several contaminants in the whale's tissues, notably mercury, PCBs, DDT and mirex. The latter two confirmed the transfer of contaminants through the food chain to the pregnant female and to the calf through the uterus.

Thus the operation provided new information on newborn beluga calves and illustrated the importance of creating a regional structure to handle incidents involving marine mammals.



# Controlling disturbances

Whether by physical and acoustic interferences or by changes to its habitat, the growth of the St. Lawrence beluga population is restricted by human disturbances. Such disturbance can cause changes in behaviour, feeding or nursing activities and even create unnecessary stress. Results of such stress on the individual's health may be dramatic, especially if coupled with other physiological aggression. Intense stress may possibly activate the metabolism of toxic substances accumulated in the whale's tissues.

Vessel traffic is the main source of disturbance, with small craft increasingly visiting critical habitats at greater speed and with greater manoeuvrability. The increasing use of outboard motors producing high-frequency sounds interferes directly with the echolocation and communication behaviour of these marine mammals. Whale-watching tours, yachting and even some scientific missions involving close observation of whales are all sources of disturbance.

In addition, the construction of public wharves and marinas and maintenance dredging operations physically modifying the habitat, also produce acoustic disturbances that have an impact on the beluga.

## *Reducing the impact of vessel traffic*

**The Guidelines** for small craft owners and tour boat captains for preventing the disturbance and harassment of whales were reviewed and modified in 1991. They were established in 1989 by Fisheries and Oceans and are reviewed annually by DFO and members of the Quebec Advisory Committee on the St. Lawrence Cetaceans. At the annual meeting of the Committee, which is composed of 10 members from the whale-

watching industry, several external observers were invited to participate in the discussion. Major changes to the guidelines were proposed in order to eliminate encircling of whales by several tour boats. These changes are:

- the minimum distance from a whale when only one tour boat is in the area remains 100 metres;
- when more than one tour boat is in the presence of whales, the minimum distance for each boat is now 200 metres;
- the distance at which boats have to reduce their speed when approaching whales is changed from 300 to 400 metres;
- encircling of whales is totally prohibited.

The beluga remains excluded from the species targeted by whale-watching; indeed a noticeable decrease in vessel traffic in the beluga's critical habitats has been observed since the implementation of these regulations. The guidelines were presented and explained to the people involved in whale-watching tours at a pre-season briefing in June 1991. This training session was given with the collaboration of the Quebec Advisory Committee, the Dufour family and the Marine Environment Education and Research Group (GREMM)

Unlike previous years when this activity was based only on a practical presentation, in 1991, theoretical training was also offered with scientific presentations and workshop discussions. This was followed by a practical demonstration of how to approach whales and by a simulation of critical situations that may occur during a whale-watching tour. Finally the theoretical and practical guidelines were reviewed.

**Monitoring activities** to protect the whales and to implement the guidelines were carried out again in

1991. More than 125 hours were devoted to sea surveillance by fisheries officers. In addition 61 hours were devoted to investigating different cases of whale harassment during the summer of 1991, resulting in eight written warnings for deliberate harassment. Belugas were not involved in any of these incidents.

Also, about 20 pleasure crafts were boarded on the Saguenay River to inform boat owners of the location of critical habitats and of the guidelines to follow for safe whale-watching. Although an improvement was noted over previous years, fisheries officers found that small craft owners were still insufficiently aware of regulations and guidelines. The information distributed at the marinas and yacht clubs on the North Shore, in the Saguenay and along the South Shore during the 1991 season clearly helped improve the situation.

Particular attention was paid to the increasing number of sea-doo's, the subject of various complaints in recent years. Again, the distribution of information helped improve the situation during the season.

**Five scientific research permits** were issued in 1991 to nongovernmental agencies or consultants involved in whale research. The impact of these studies on the beluga were minimized through a co-ordination plan, involving a new identification system for boats operating under a scientific research permit. Boats must now fly a beluga flag at all times showing the year for which the permit was issued.

## *The Saguenay marine park*

Undoubtedly the most spectacular project under the *St. Lawrence Action Plan* is the establishment of a marine park at the confluence of the Saguenay and the St. Lawrence. It will result in the conservation and protection of marine resources unique in the world and of several of the critical habitats of the St. Lawrence beluga.

A bilateral agreement was signed in 1990 between Canada and Quebec and public hearings were held in the fall of 1990 to define the boundaries of the park. A final decision has yet to be made, both levels of government agreeing that the total area of the park should cover 1200 km<sup>2</sup> rather than the 750 km<sup>2</sup> initially proposed.

A research project has been initiated by the Canadian Parks Service to synthesize and analyse all the information available on the natural resources of the Saguenay and the St. Lawrence estuary, through an exhaustive literature review. This project will form the basis for resource enhancement and protection programs, and for management guidelines. It evaluates the information and data available and highlights the major issues, such as the protection of the beluga population. It synthesizes over 600 documents, research projects and scientific publications; the data will be included in a computerized database.



# Reducing toxic substances

The many autopsies performed on stranded belugas have clearly revealed high concentrations of several toxic substances in tissues, especially in the blubber. The survival of the St. Lawrence beluga hinges on defining the environmental toxicity of these contaminants, characterizing their flux and pathways in the food chain, determining how they are transported in the river system, and above all, controlling and reducing pollution sources in the river and estuary.

## *Environmental toxicity of contaminants*

Since 1988, the sublethal effects of several contaminants on fish in the river portion and the mid-estuary of the St. Lawrence have been under study. The purpose is to identify simple, reliable bio-indicators for quick assessment and monitoring of the quality of aquatic habitats. Sampling has been conducted in Lake Saint-François, Lake Saint-Louis, Lake Saint-Pierre and in the mid-estuary of the St. Lawrence. Preliminary results show that piscivorous species in the river are subject to generalized environmental stress, especially in the upstream sector. The situation is similar for the Atlantic tomcod in the estuary. Bio-indicator response is noticeably higher in the white sucker, the northern pike and the Atlantic tomcod. The semi-quantitative histology of gill tissue offers good potential as an environmental stress indicator.

An experimental protocol for ecotoxicological evaluation in a diluted environment has been under development since 1990. It attempts to discriminate sublethal effects in fish populations found either upstream or downstream of the Beauharnois industrial zone. Finally, a review of pathological phenomena observed in St. Lawrence fish was conducted.

## *Contaminant flux in the beluga's food chain*

Since the beluga is at the top of a food chain including organisms living in sediment, phytoplankton, zooplankton, invertebrates and fish, the presence of toxic substances has to be determined at all levels.

**Sediment** has been the object of two research projects conducted in the estuary and the Saguenay fjord since 1988. One project studied three specific aspects: the accumulation rate of various contaminants in the sediments of the Laurentian Channel, historical trends in the accumulation of contaminants in sediments, and natural biodegradation of PAHs by benthic bacteria in sediments in the Saguenay fjord. The main results to date show that PCB levels in the sediments of the Laurentian Channel are ten times lower than in the sediments of Lake Ontario. However, in recent years the accumulation of PCBs has decreased in Lake Ontario, but has remained stable in the Laurentian Channel. Also, in 1991-1992, the potential biodegradation rate of PAHs by bacteria was studied, and an estimate of the total number and of the most probable number (MPN) of bacteria capable of biodegradation was undertaken in the sediments and the bottom waters of the Saguenay.

The objective of the second project on sediment is to determine the distribution and the accumulation rate of organic contaminants in sediments and to assess their potential release in the aquatic environment. Preliminary results indicate that concentrations of hydrocarbons are relatively low, but with some fairly high local sources.

Other projects focus on the river section between Cornwall and Trois-Rivières. Results have shown that total PCB concentrations have substantially decreased in

Lake Saint-François, while mercury levels have decreased only slightly. However, in terms of sediment quality criteria, Lake Saint-François remains highly polluted by certain metals, notably arsenic.

Sediment dynamics, including an evaluation of residence time, is also under investigation in the river between Cornwall and Trois Rivières. Sediment sampling was conducted for a second time in 1991-1992. Preliminary results indicate that residence time of sediments in Lake Saint-François, Lake Saint-Louis and Lake Saint-Pierre varies greatly, the shortest being in Lake Saint-Pierre with a residence time of six months. This is probably the result of the dynamics of aquatic vegetation and the hydrological cycle in this water body.

Finally, a project to characterize sediment quality in Lake Saint-Louis was initiated in 1991-1992, in a small pilot study area between Ile Perrot and Montreal Island.

**A large-scale study on phytoplankton and zooplankton** is being conducted to assess whether these trophic levels play a major role in introducing, accumulating and transferring organic compounds through the food web, or if the microbial loop is more responsible. Contaminants have been found at all levels, with greater concentrations at higher levels. Significant seasonal variability has been noted, and concentrations were found to be higher near Quebec City than in the lower estuary and the Saguenay. High levels of contamination measured in spring may indicate an important source of pollution upstream from Quebec City.

Four bacteria size classes have been identified, with great seasonal variability in their respective proportions. Contaminant incorporation in these size classes is still unknown.

The bioaccumulation of heavy metals in phytoplankton and their transfer through the trophic chain in the St. Lawrence River between Cornwall and Quebec City are being investigated. Two field missions have already been conducted in Lake Saint-Pierre (1990-1991) and Lake Saint-Louis (1991-1992) and three transects were sampled in the river itself. Results will be available in the spring of 1993.

**Invertebrates and fish** are good indicators of contamination as they are near the top of the beluga's food chain. Research on contaminants and their toxicity in fish and benthic invertebrates in the Saguenay fjord and the St. Lawrence estuary has been underway since 1990. For most chemical compounds investigated (PCB,

PAH, chlorinated pesticides, heavy metals) concentrations are low, except for mercury whose levels in some cases are above the acceptable norm for human consumption.

Contamination gradients were found in snow crab and shrimp between the upper Saguenay and the mouth of the river. There is no evidence to date of biochemical, hematological or pathological changes caused by chemical pollution in the Saguenay, unlike in Baie des Anglais where a high incidence of external wounds, parasites and viral infections were observed. During the course of this research project, 160 benthic species were identified for the first time in the Saguenay, and in some cases, for the first time in Canada.

Another study seeks to produce a biotic integrity index model from analysis of the structure and state of the fish communities. A model was developed and validated, in 1991, from the results of a sampling conducted in 1989 at six sites between Ile d'Orléans and Tadoussac.

Finally, an ecosystem evaluation index based on the biotic integrity of invertebrate communities is under development. This index has already been tried in Lake Saint-François and in the main water bodies near Montreal, using historical data from the *Archipelago Project*.

## Transport of pollutants

As part of the *St. Lawrence Action Plan*, the sources of toxic substances in the St. Lawrence are under investigation. The ultimate objectives of this program are to understand the mechanisms of transport and to assess the inputs and outputs of toxic substances in the St. Lawrence and measure their respective impacts on the beluga population.

Several studies, initiated or pursued in 1991-1992, focused on the dynamics of contaminant transportation in the river system from four major sources: the Great Lakes, the 50 most polluting industries targeted by the *St. Lawrence Action Plan*, certain tributaries of the St. Lawrence, and 40 of Quebec's major municipalities.

Thus, a hydrodynamic model of Lake Saint-Pierre was developed to provide essential data on currents in the river system. Also a plume dispersion model was elaborated to better understand transport and dispersion of contaminants from industrial and urban effluents.



The seasonal inputs of contaminants were measured and characterized in four major tributaries of Lake Saint-Pierre, taking into account their hydrological regime. Another 50 tributaries of the St. Lawrence were also sampled during the summer and fall of 1991. Those with high pollution levels will be sampled again in the spring of 1992.

Other studies initiated in 1991-1992 are investigating the concentrations and transport of contaminants near the surface in order to evaluate the toxicity of the St. Lawrence surface waters.

## *Controlling toxic waste*

Control of toxic waste in the St. Lawrence is essential in order to improve the habitat of the beluga. Industrial pollution has to be reduced and efficient environmental emergency intervention plans have to be established.

**To further reduce industrial pollution**, continuous efforts were made in 1991-1992 under the *St. Lawrence Action Plan* which aims to eliminate, by 1993, 90% of the total liquid toxic waste discharged into the river by the 50 most polluting industries.

As at March 31, 1992, the industrial effluents of 47 companies had been analysed; 45 industries have either

produced corrective measures approved by the Quebec Department of the Environment or are subject to current legislation. Also, decontamination and clean-up work has been completed for 17 industries and is underway at 10 other companies.

A provisional assessment of progress in reducing toxic waste since 1988 was carried out in 1991. Thirty-six industries have so far eliminated up to 90% of one or more contaminants found in their effluents

**Environmental emergencies** were the object of two different projects. First, the review of the Marine Environmental Emergency Response Plan initiated in 1990 was finalized in 1991-1992. Intervention teams are now better structured and should be more efficient in case of ecological disasters. Two teams of experts are now responsible for assessing short term impacts of oilspills on fish and habitats and for devising research projects tailored to each individual situation. These projects should help increase our knowledge of the effects of oilspills on aquatic habitats and marine resources. In 1991, six requests were made for expertise during minor marine incidents.

The other project is concerned with the elaboration of an emergency plan for the Saguenay Marine Park. Risk analysis has been completed and prevention strategies and intervention procedures developed. Essentially, the objective of this emergency plan is to protect habitats within the park limits, including the critical habitats of the beluga.





# Communicating information

The fourth theme of the Action Plan centres on information communication, covering activities and publications to increase knowledge and awareness on the part of the general public of the conservation issue surrounding the St. Lawrence beluga population.

## Communicating scientific information

In 1991-1992, scientific information was released mostly through scientific articles and documents, and through seminars and conferences.

**Scientific and technical publications** produced by research scientists from Environment Canada and Fisheries and Oceans dealt with various aspects of protection of the beluga population: **increasing our knowledge of the beluga** and **reducing toxic substances**. A complete list of the 1991-1992 publications is presented below.

In addition, two atlases were published in the Canadian Technical Report of Fisheries and Aquatic Sciences series. The first atlas entitled *Localisation des sites de reproduction des principales espèces de poisson du fleuve Saint-Laurent* (Cornwall-Montmagny) has 16 maps. The second atlas, *Modifications de l'habitat du poisson dans le fleuve Saint-Laurent de 1945 à 1988*, consists of 69 maps.

**Several scientific presentations** on research projects sponsored by the Interdepartmental Action Plan were made by research scientists. Thus a paper was given on the chemical contamination of surface sediments and of the biotope of the Saguenay fjord at the 7th Eastern Canada Symposium on Water Pollution Research, held at Rimouski in September 1991.

At the 18th Annual Workshop on Aquatic Toxicity held in October 1991 in Ottawa, the results of two research projects were presented: contamination levels of recent sediments in the Upper Saguenay, and the use of histological analysis of fish liver and gills as an indicator of the quality of fish habitats in the St. Lawrence.

Finally, two presentations were made at the 12th Annual meeting of the Society for Environmental Toxicology and Chemistry, held in Seattle, USA, in November 1991. The chemical contamination of catadromous American eels in the St. Lawrence estuary, and a model of contaminant accumulation in the St. Lawrence beluga were discussed.

## Promoting public awareness

Another facet of information dissemination takes the form of promoting public awareness of the issue of beluga conservation in the St. Lawrence. Various tools such as publications, information sessions, information booths, exhibitions and even interactive educational computer software were used in transmitting information to the general public.

**Publications** constitute the core of the information campaign. Bulletins, reports, factsheets, thematic maps, newsletters and brochures were all used to increase public awareness.

Two issues of the newsletter *Beluga* were produced in 1991-1992. In November 1991, the third annual reports of the *St. Lawrence Action Plan* and of the *Interdepartmental Action Plan to Favour the Survival of the Beluga* were released in Montreal and received a wide media coverage.

The St. Lawrence Action Team, formed of representatives of both federal and provincial departments of the Environment, published 19 reports describing the effluents of as many polluting industries and also a series of factsheets concerning the 50 most polluting industries targeted by the *St. Lawrence Action Plan*. In these factsheets basic information on the nature of the effluents discharged in the river, their current and desirable treatment, and the potential impacts of these discharges on the St. Lawrence's aquatic resources are discussed.

Factsheets aimed at the general public were produced for ten species of fish, some of whose populations are in a precarious situation in the St. Lawrence River. Also, a map presenting the fields and areas of activities of Fisheries and Oceans in Quebec was issued; the most sensitive areas for the survival of the St. Lawrence beluga are shown in an inset.

Several brochures were published and distributed at symposia, conferences and various exhibitions held in 1991-1992. Around 75 000 copies of a factsheet in the St. Lawrence Update series entitled *The Saguenay marine park ... a unique environment in the middle of a continent* was distributed. It describes the fragility of the beluga population and the concerted efforts of governments to improve the overall quality of the Saguenay River and to create a marine park to protect this unique environment.

The *Underwater World* factsheet on the beluga was translated into three Inuktitut dialects of the Canadian Arctic, since several beluga populations are found in these northern waters.

Two brochures were distributed to the public. *Watching whales without harassment* describes the general and specific guidelines relating to whale watching; *Guidelines for small craft owners for preventing the disturbance of*

*St. Lawrence belugas* deals with specific guidelines concerning belugas and includes a tide table along with the location of critical habitats.

**Information sessions** held during exhibits or at information booths is another tool used to promote public awareness. Thus 21 marinas and interpretation centres in the Quebec City, Saguenay and St. Lawrence estuary regions were visited to explain the guidelines and regulations relating to whale watching during July 1991.

Documentation was also sent to 18 other marinas, yachting schools and summer camps, and to six school boards and 11 CEGEPS. In total, more than 800 posters, including *There are limits to observe*, and 10 000 brochures were distributed at strategic locations along the St. Lawrence.

Developed in 1990-1991, the information display booth on the St. Lawrence beluga was exhibited at the Annual meeting of the Quebec Biologists Association held in November 1991 in Montreal. The booth is made up of ten panels presenting texts and illustrations in both official languages. Three themes are presented: **observe, understand and act**. It is available to all nongovernmental agencies that wish to use it for their public information activities. Finally an exhibition mounted by the Linnean Society was presented at the Pointe Noire interpretation centre. It dealt with issues relating to the preservation of natural resources in the Saguenay Marine Park

**A second educational computer program**, *The Navigator*, has become a complement to the *Delphi* program which dealt specifically with the feeding behaviour of the beluga. *The Navigator* is an interactive program simulating various approach techniques by whale-watching crafts and the application of observation guidelines; problems encountered by the beluga when harassed are experienced by the users.



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## Publications appearing in 1991-1992:

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### *Increasing our knowledge*

Kingsley, M.C.S.(ed.) 1991. Proceedings of the Symposium and Workshop on the Research Plan for the Beluga of the St. Lawrence, March 5 and 6 1991. Can. man. rep. fish aquat. sci. 2126: 44 p.

Kingsley, M.C.S. et M.O. Hammill. 1991. Photographic Census Surveys of the St. Lawrence Beluga Population, 1988 and 1990. Can. tech. rep. fish. aquat. sci. 1776:v+19 p.

Marquis, H., J. Therrien, P. Bérubé, G. Shooner et Y. Vigneault. 1991. Modifications physiques de l'habitat du poisson en amont de Montréal et en aval de Trois-Pistoles de 1945 à 1988 et effets sur les pêches commerciales. Rapp. tech. can. sci. halieut. aquat. 1830F:xi+80 p.

D.E.C., MENVIQ, M.L.C.P. 1991. Symposium sur le Plan d'action Saint-Laurent, les 9 et 10 octobre 1990. Compte rendu des ateliers. 211 p.

Michaud, R. 1991. Évaluation d'une méthode de recensement par bateau pour estimer la composition de la population des bélugas du Saint-Laurent. 42 p.

Michaud, R. 1992. Fréquentation de la Baie Sainte-Catherine par le Béluga du Saint-Laurent (*Delphinapterus leucas*). Rapport présenté au ministère des Pêches et des Océans. 34 p.

Michaud, R., J. Giard, R. Patenaude, S. de Guise et P. Béland. 1991. Tentative de sauvetage d'un jeune béluga orphelin - Notes et observations. Rapport présenté au ministère des Pêches et des Océans du Canada, Division de la gestion de l'Habitat du poisson, Région de Québec. 15 p. + annexes.

Robitaille, J. A., L. Choinière et Y. Vigneault. 1991. Identification des populations de poissons d'intérêt économique en situation précaire dans le réseau du Saint-Laurent et sélection des espèces pour des interventions immédiates. Rapp. tech. can. sci. halieut. aquat. 1810:ix+24 p.

### *Reducing toxic substances*

Gobeil, C. 1991. Inventaire de la contamination des sédiments du chenal Laurentien: données sur les métaux et les éléments nutritifs. Rapp. stat. can. sci. halieut. aquat. 854: iV+ 63 p.

Gobeil, C. et M. Lebeuf. 1992. Inventaire de la contamination des sédiments du chenal Laurentien: les biphenyles polychlorés. Rapp. tech. can. sci. halieut. aquat. 1851:iv+45 p.

Gonthier, C. 1991. Bilan provisoire de la réduction des rejets des 50 industries du Plan d'action Saint-Laurent. Équipe d'intervention Saint-Laurent.





# Conclusion

Now in its fourth year, the *Interdepartmental Action Plan to Favour the Survival of the St. Lawrence Beluga* has already produced significant results in reducing industrial pollution in the St. Lawrence River, and in assessing the dynamic processes that influence contamination and its impacts on the beluga. Important steps have also been taken in an effort to reduce and control human activities interfering with the beluga. Interest in this Action Plan is reflected not only in the considerable financial and human resources invested by Environment Canada and Fisheries and Oceans, but also in the number of enquiries from the general public: more than 150 requests for information were received in 1991-1992, with a substantial proportion coming from students at the elementary and secondary levels.

In the following sections, a financial summary and a summary of results are presented for the 1991-1992 fiscal year. If the St. Lawrence beluga, now a symbol of water quality in the river system, is to survive, the Action Plan has to be pursued with sustained efforts to restore and protect the whale's habitat.

## Financial summary

The following table presents the financial balance sheet for the period covering April 1991 to March 1992. It shows the breakdown of funding by department for

## Expenditures allocated to the Action Plan

THEMES	EXPENDITURES (\$)			
	Fisheries and Oceans		Environment Canada	
	FHMB	RSB	CP	PS
Increasing our knowledge .....	217 000	176 100	—	160 000
Controlling disturbances .....	11 000	—	—	—
Reducing toxic substances .....	123 000	155 700	2 180 000	—
Communicating information .....	81 400	43 400	60 000	60 000
<b>Total for 1991-1992 .....</b>	<b>432 400</b>	<b>375 200</b>	<b>2 240 000</b>	<b>220 000</b>
<i>Forecast for 1992-1993 .....</i>	<i>512 000</i>	<i>286 000</i>	<i>968 000</i>	<i>110 000</i>

FHMB:  
Fisheries and Habitat Management Branch  
RSB:  
Regional Science Branch  
CP:  
Conservation and Protection  
PS:  
Parks Service

each of the various activities and gives a budget forecast for the 1992-1993 fiscal year.

According to this table, over \$2,4 million was contributed by Environment Canada and over \$800 000 by Fisheries and Oceans on activities in line with Plan objectives and results. Allocations to the Action Plan in 1992-1993 should total almost \$1,1 million from Environment Canada and close to \$800 000 from Fisheries and Oceans.

## Summary of results

Significant results have been obtained through several research projects initiated under the Action Plan. The following section summarizes the most pertinent results relating to each of the four themes of the plan.

**With regard to increasing our knowledge**, it now seems that the beluga population is actually stable. This was confirmed by recent censuses of the population and by the proportion of young animals observed (30%).

Baie St.Marguerite was confirmed as a critical habitat widely frequented by the beluga, although, as in the rest of the Saguenay River, newborn calves were fairly rare. Three distinct social units were identified in the bay: pods with adults only, pods with adults and juveniles, and pods with adults, juveniles and neonates.

The contamination level in the beluga has remained stable since 1988, according to the 44 autopsies on stranded whales, 16 of which were done in 1991-92. A contaminant acculuation model points at contaminant transfer from cow to calf during pregnancy and at consumption of American eels as the causes for this phenomenon, although concentrations of PCBs and mirex in eel tissues from Kamouraska have considerably decreased since 1982. Another study shows that contamination level is low in this region and that benthic organisms are not an important direct source of toxic substances for the St.Lawrence beluga.

The *Beluga* database in the Integrated Information System for Fish Habitat Management (I.I.S.F.H.M.) is now functional; it holds data on species distribution by sector and on the distribution of potential preys. The program is supported by distribution maps.

The rescue attempt of a beluga calf in August 1991 provided new information on the diet, health care requirements, behaviour and vital signs of newborn calves, and further confirmation of contaminant transfer from cow to calf.

**Controlling disturbances** of the beluga was improved upon by modifying the whale-watching guidelines. The minimum distance between a whale and a tour boat was increased when more than one boat is in the area, and encircling of whales was totally prohibited. More than 125 hours of sea surveillance were devoted to whale protection and enforcement of regulations. Investigations, involving 61 hours, were conducted on marine mammal harassment and resulted in eight written warnings. Finally five research permits were issued, conditional on clear and continuous identification of the research vessels by a beluga flag.

**In connection with reducing toxic substances** there is much to mention. Several species of fish are subject to environmental stress from chemical pollution. Stress level can be detected by a simple analysis of gill tissues.

PCB concentrations in the bottom sediments of the Laurentian Channel are ten times lower than in Lake Ontario, but are not decreasing as is the case with Lake Ontario. In Lake Saint-François, there has been a marked decrease of certain pollutants in the sediments over the past 10 years; however the current levels of certain metals are still above accepted sediment quality criteria. Also it was confirmed that the residence time of sediments is six months shorter in Lake Saint-Pierre than in Lake Saint-François and Lake Saint-Louis.

Traces of contaminants were found in bacteria, in phytoplankton and in zooplankton. Concentrations increase with the trophic level and vary considerably with the season, with levels higher near Quebec City than in the lower estuary and the Saguenay. High spring concentrations suggest a major source of pollution upstream from Quebec City.

For most chemical compounds, concentrations in fish and invertebrates are low, except for mercury levels in the Saguenay fjord and the St.Lawrence estuary. For crab and shrimp caught in the Saguenay, there is evidence of a mercury contamination gradient, with concentrations increasing upstream.



Finally, the toxic waste reduction program aimed at the 50 industries targeted by the *St. Lawrence Action Plan* was continued in 1991-1992, as was the development of emergency plans.

**Concerning information communication** and public awareness, more than a dozen scientific publications were produced and over one hundred brochures, bulletins, maps and factsheets were distributed. In addition five presentations were given at various symposia, information sessions were conducted and an information booth was mounted, posters were distributed, 21 marinas visited and a new educational software package was made available to the public.

## Upcoming activities

The overall collection of projects and activities will be continued in 1992-1993. The following section presents new projects or research of particular interest related to each of the themes of the Action Plan.

### *Increasing our knowledge*

Investigation of the population dynamics of the St. Lawrence beluga in 1992-1993 will include two population censuses during summer and studies on the genetic variations in Arctic beluga populations other than those studied in 1990-1991.

Research will be conducted on contamination in the American eel and the transfer of toxic substances to the beluga. Eel pathology and diseases will be investigated with the help of commercial fishermen and fish processing plants. The spatial distribution of both belugas and eels will be reviewed using aerial surveys and validation of the contaminant accumulation model will be conducted. The potential input of toxic substances by fish and benthic organisms from the Saguenay will also be evaluated.

The validation of the three-dimensional water flow model of the St. Lawrence estuary will be attempted through bathymetric soundings, tide and flow recordings, and wind measurements. Current meters will also be moored in the northwestern Gulf of St. Lawrence in order to calibrate the open face of the model.

### *Preventing disturbances*

Visits to marinas will be extended to the Montreal and North Shore areas. For the first time, park rangers in the Saguenay Marine Park will be involved in whale-watching surveillance patrols. In addition, management proposals will be prepared as part of the development of the Marine Park master plan.

### *Reducing toxic substances*

In 1992-1993, data on environmental quality from the St. Lawrence Centre will be incorporated in the study of sublethal effects of contaminants in the St. Lawrence. Data will be analysed and the results will be published.

For the dilution study to produce the ecotoxicological assessment tool, chemical analysis of PAH and PCB metabolites will be conducted in fish; inorganic contaminants in liver tissues will also be measured. Data collected since 1990 will be synthesized and a report on fish pathologies in the St. Lawrence will be produced.

Assessment of contaminant transfer through the trophic web or microbial loop will proceed through an experimental laboratory study using flow cytometry of PAH incorporation by bacterial strains. Finally the ecosystem evaluation index based on the biotic integrity of invertebrate communities will be calibrated during the final field trials.

### *Communicating information*

Several reports and scientific articles are either in preparation or in press and will be published in the coming year.



# Activities related to the Action Plan

ACTIVITIES	PARTICIPATING DEPARTMENTS			
	Fisheries and Oceans		Environment Canada	
	FHMB	RSB	CP	PS
<b>INCREASING OUR KNOWLEDGE OF THE BELUGA</b>				
<b>The St.Lawrence beluga population</b>				
• The St.Lawrence beluga population .....				
• The distribution of the beluga population .....				
• The population dynamics .....				
<b>Limiting factors</b>				
• The stress .....				
• The contaminants .....				
• The beluga's diet .....				
<b>Habitat conservation</b>				
• The I.I.S.F.H.M. ....				
• The three-dimensional water current model .....				
The rescue of a young beluga .....				
<b>CONTROLLING DISTURBANCES</b>				
<b>Reducing the impact of vessel traffic</b>				
• The guidelines .....				
• The monitoring of activities .....				
• The scientific research permits .....				
The Saguenay marine park .....				
<b>REDUCING TOXIC SUBSTANCES</b>				
Environmental toxicity of contaminants .....				
Contaminant flux in the beluga's food chain				
• The sediments .....				
• The phytoplankton and zooplankton .....				
• The invertebrates and fish .....				
Transport of pollutants .....				
Controlling toxic waste				
• The industrial pollution .....				
• The Environmental Emergency .....				
<b>INFORMATION</b>				
<b>Communicating scientific information</b>				
• The scientific and technical publications .....				
• The scientific presentations .....				
<b>Promoting public awareness</b>				
• The Publications .....				
• The information sessions .....				
• The computer program .....				

FHMB:  
Fisheries and Habitat Management Branch  
RSB:  
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